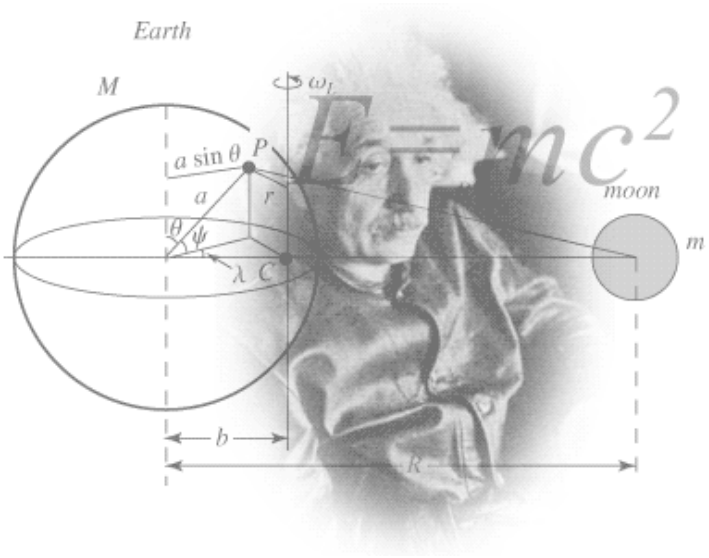

UNIVERSITY OF SOUTH CAROLINA

DEPARTMENT OF PHYSICS AND ASTRONOMY

GRADUATE STUDENT HANDBOOK
2011 – 2012

Vladimir Gudkov
Director of Graduate Studies

UNIVERSITY OF SOUTH CAROLINA
DEPARTMENT OF PHYSICS AND ASTRONOMY
Graduate Student Handbook
2011-2012

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This handbook is intended to compliment and reflect The Graduate School's regulations as outlined in the *Graduate Studies Bulletin* (http://bulletin.sc.edu/). It outlines the Department of Physics and Astronomy's academic requirements for the Master of Science and Doctor of Philosophy programs. In certain circumstances, exceptions to these requirements may be made by the entire faculty. Graduate students are encouraged to become familiar with the policies outlined in both this handbook and the *Graduate Studies Bulletin*.

I. EXPECTED UNDERGRADUATE BACKGROUND

Prior to their admission to this department, entering graduate students are expected to have passed with a grade of C or better the following courses or their equivalent:

Quantum Physics (PHYS 501, 502)
Mechanics (PHYS 503)
Electromagnetic Theory (PHYS 504)
Kinetic Theory and Statistical Mechanics (PHYS 506)
Nuclear Physics (PHYS 511)
Solid State Physics (PHYS 512)

Mathematics through Advanced Calculus, including ordinary and partial differential equations and vector analysis, also should have been completed in the undergraduate program. Students with deficiencies in these courses must make them up during their initial two years of graduate studies as explained in the M.S. and Ph.D. Program Requirements.

II. COURSE REGISTRATION AND ACADEMIC ADVISEMENT

The department has an advisement committee, which provides academic advisement for all M.S. students and Ph.D. students. These students should consider the Advisement Committee to be their official advisor.

Students should register via the Visual Information Processing system (VIP) after being advised by the Advisement Committee or their advisor. Please note the following:

- A departmental advisement form must be filled out in consultation with the advisor and the Director of Graduate Studies.

- Students who did not passed A-to-C exam will be required to take up to 12 academic hours of courses; students who passed A-to-C exam will be require to take up to 9 academic hours.
- All students cannot drop any credits without approval from the Advisement Committee.

- All teaching assistants must be enrolled in at least one credit hour during one summer session.
- Research (PHYS 760 and PHYS 761) must be approved by the professor in charge.
- Thesis Preparation (PHYS 799) and Dissertation Preparation (PHYS 899) must be approved by the professor in charge and the Director of Graduate Studies.
- Changes in the approved course schedule made after advisement must have the consent of the Director of Graduate Studies.
- The Advisement Committee will recommend specific actions to the Physics faculty if these advisement procedures are not followed. Failure to follow the Advisement Committee's recommendations may result in immediate termination of TA appointments.

III. GENERAL ISSUES

- All teaching assistants are expected to spend 20 hours per week on teaching duties, as per university policy.
  - All TAs must be on campus no later than the official Faculty Reporting Day at the beginning of the fall semester, and at least 3 working days before classes begin for the spring semester.

The TA appointment is given for one year and is subject to annual evaluation before renewal.

- All students must maintain an e-mail address and inform the Assistant to the Director of Graduate Studies of their current address, phone number, and e-mail address. Any changes should be reported as soon as possible.
- Graduate students are strongly encouraged to utilize research resources within the department. In particular, they should participate in colloquia and seminars both by attendance and by making their own presentations.
- Students, who passed A-to-C exams, are required to have a PhD committee be formed within 6 months. This committee will review the performance of students each semester to monitor education and research performance of students to ensure efficient and timely progress to the completion of their PhD degrees.

- At the end of each academic year all students are required to complete a "Resume of Activity" form which addresses individual education/research performance (courses taken, labs taught, abstract submitted, presentations done, etc.). This form (together with the assessment mentioned above for students who have passed the A-to-C exam) will be used for evaluating the student's performance and renewal of TA appointment.
- If a student receives a grade of D+ or below in a course, he/she must re-take the course.
- Students are encouraged to keep in touch with the department after they graduate. We urge them to inform us of their new address, phone number, and e-mail address.

IV. FIRST AND SECOND YEAR OF GRADUATE STUDY

The Advisement Committee will closely follow the student's performance. At the beginning of each semester, the committee will advise the students to:

1. pursue further graduate work in physics,
2. work toward an M.S. degree, or
3. pursue the Ph.D. program.

If the student has finished his/her M.S. and wants to continue with the Ph.D. program, and the student has not been accepted by the faculty into the Ph.D. program (#3 above), the student should apply to the Admission Committee, which will decide whether or not to accept the student into the Ph.D. program. If accepted, the first attempt at the Admission to Candidacy Exam should be made before the beginning of the third year of graduate study. Consequently, the student should plan his/her program of study in such a way that at the end of the third year all of the required courses have been taken.

V. SEQUENCE OF EVENTS

Sequence of Events for an M.S. degree:

1. Courses
2. File program of courses
3. Thesis given to Director of Graduate Studies, thesis director, and second reader (the student must make an appointment with The Graduate School to review his/her thesis immediately following a successful presentation)
4. Thesis defense and Comprehensive Exam at least 30 days before graduation

Sequence of Events for a Ph.D. degree

1. Courses
2. Admission to Candidacy Exam after one/two years
3. Residency requirement
4. Ph.D. committee to be formed
5. Program to be filed with The Graduate School
6. Proposal submitted to Director of Graduate Studies and Ph.D. committee members
7. Proposal defense and Comprehensive Exam at least one week later but no more than six months after the Admission to Candidacy Exam
8. Ph.D. dissertation to be defended at least one year but no more than five years after the Comprehensive Exam
9. Dissertation to Director of Graduate Studies and Ph.D. committee members (the student must make an appointment with The Graduate School to review his/her dissertation immediately following a successful presentation)
10. Dissertation defense at least two weeks after dissertation is submitted to Director of Graduate Studies and Ph.D. committee members (dissertation defense must take place at least 30 days before graduation)

VI. MASTER OF SCIENCE REQUIREMENTS

Students working toward an M.S. degree are required to file a Program of Study as stated in the *Graduate Studies Bulletin*. Some credit for courses completed at other institutions may be granted by the Director of Graduate Studies subject to restrictions specified in the *Graduate Studies Bulletin*.

Summary of Requirements
Course Work
Thesis
Comprehensive Examination
Thesis Defense

Course Work

A minimum of thirty semester hours of course work is required. At least 18 hours of the minimum course credit requirements must be obtained in graduate courses (700 level). Quantum Mechanics (PHYS 711) and one of the following:

Classical Mechanics (PHYS 701)
Electromagnetic Theory I (PHYS 703)
Electromagnetic Theory II (PHYS 704)

Statistical Thermodynamics (PHYS 706)
Quantum Mechanics (PHYS 712)

must be included in the program. Up to 6 hours of Thesis Preparation (PHYS 799) may be counted. The following courses are not applicable to the 18-hour minimum requirement:

Graduate Seminar (PHYS 730)
Selected Topics in Physics (PHYS 740)
Research (PHYS 760 and PHYS 761)

It is expected that the entering student has taken the seven 500-level courses or their equivalents mentioned earlier. If some of these 500-level courses or their equivalents have not been taken, they must be completed during the initial two years of graduate studies. Up to 12 hours of 500-level courses can be used to complete the 30-hour requirement.

Thesis
The thesis involves either (a) the solution of an acceptable research problem chosen by the student or suggested by his/her advisor, or (b) a lucid, informative discussion, in the nature of a review article and not obtainable elsewhere, on some currently important topic.

Comprehensive Examination
The student must pass a comprehensive oral examination which covers material contained in the Bachelor of Science program, as well as graduate-level work which the student has completed at the time. The examination is ordinarily administered as part of the thesis defense.

Thesis Defense
The student must submit the thesis to the Director of Graduate Studies and faculty committee consisting of the thesis director and one reader at least two weeks before the date of the examination. The committee will administer the comprehensive examination/thesis defense. A satisfactory performance is required for a degree.

VII. SAMPLE M.S. PROGRAM

First Year

Fall Semester

PHYS 501	Quantum Physics (3 credits)
PHYS 503	Mechanics (4 credits)
PHYS 506	Thermal Physics (3 credits)
PHYS 515	Mathematical Physics I (3 credits)
PHYS 730	Graduate Seminar (1 credit)

File the degree program

Spring Semester

PHYS 502	Quantum Physics (3 credits)
PHYS 504	Electromagnetic Theory (4 credits)
PHYS 512	Solid State (3 credits)
PHYS 730	Graduate Seminar (1 credit)
PHYS 761	Research (2 credits)

Second Year

Fall Semester

PHYS 711	Quantum Mechanics I (3 credits)
PHYS 7xx	700-level courses (6 credits)
PHYS 730	Graduate Seminar (1 credit)
PHYS 760	Research (2 credits)

Spring Semester

PHYS 511	Nuclear Physics (4 credits)
PHYS 7xx	700-level course (3 credits)
PHYS 761	Research (1 credit)
PHYS 799	Thesis Preparation (4 credits)

500-level courses may or may not be necessary depending on the student's prior preparation.

VIII. DOCTOR OF PHILOSOPHY REQUIREMENTS

The Ph.D. degree is awarded to those students who have satisfied the faculty that their knowledge of, and insight into, physics and their demonstrated ability in planning and carrying out research publishable in standard refereed physics journals have prepared them for a scholarly career in physics with the potential for continued professional growth and achievement. The primary means of demonstrating this is a dissertation based on original research carried out by the student. M.S. degree students who have finished their M.S. degree at USC and want to continue with the USC Ph.D. program should apply to the Admissions Committee.

Some credit for courses completed at other institutions may be granted by the Director of Graduate Studies subject to restrictions specified in the *Graduate Studies Bulletin*.

Summary of Requirements
Course Work
Admission to Candidacy Examination
Residency Requirement
Foreign Language
Teaching Experience
Dissertation Proposal and Comprehensive Examination
Dissertation
Dissertation Defense

Course Work

A minimum of sixty semester hours of graduate-level course work is required (or 30 past an M.S. degree). The minimum course requirements for the doctorate are satisfactory completion of:

PHYS 701	Classical Mechanics (3 credits)
PHYS 703	Electromagnetic Theory I (3 credits)
PHYS 704	Electromagnetic Theory II (3 credits)
PHYS 706	Statistical Thermodynamics (3 credits)

PHYS 711	Quantum Mechanics I (3 credits)
PHYS 712	Quantum Mechanics II (3 credits)
PHYS 713	Advanced Quantum Theory (3 credits)
PHYS 7xx	Advanced 700-level courses (9 credits)

For less well-prepared students, the seven 500-level courses or their equivalents mentioned earlier must be completed during the initial two years of graduate studies. All students are expected to take one or more advanced graduate courses in fields outside of their specialty to broaden their background. Before deciding upon a research field, a student may take Research (PHYS 760 or 761) to become familiar with the research work being carried out by a particular research group.

The twelve credits of advanced graduate courses may include both regular courses (no limit) and topics courses (no more than 3 credit hours) but should exclude Graduate Seminar (PHYS 730), Selected Topics in Physics (PHYS 740), Research (PHYS 760 and 761), and Dissertation Preparation (PHYS 899). Review courses of 700-level should also be excluded. If the Advisement Committee finds the student deficient in his/her mathematical background, then the committee may require the student to take Mathematical Physics I and II (PHYS 515 and 516).

Admission to Candidacy Examination ("A to C" or Qualifying Examination)
The purpose of the Admission to Candidacy Examination is to determine whether the student is sufficiently well-grounded in fundamental subject matter of the field of physics, since only then will he/she be permitted to undertake a doctoral research program. Passing this exam is a prerequisite to attain the final designation of "Ph.D. Candidate" and to the submission of a dissertation proposal. A student will be permitted no more than two attempts at the entire exam. The first attempt must be made before the beginning of the third year, and the second attempt must be passed by the beginning of the fourth year of graduate study. The exam will be given only once a year (normally in January).

Students can attempt the first A to C Exam of the year they join the department if allowed to do so by the Advisement Committee. In this case only, failure in the exam will not be counted against the allowed maximum of two attempts.

The examination will consist of four written parts and will cover the material normally given in a standard physics major undergraduate program plus that in the graduate-level courses: Classical Mechanics (PHYS 701), Electromagnetic Theory (PHYS 703 and 704), and Quantum Mechanics (PHYS 711 and 712), which must have been satisfactorily completed before taking the A to C Exam. The exam will be administered by a faculty committee and graded by the faculty.

If the student fails the first attempt, the exam must be repeated the following year. Students are allowed to repeat failed sections in the second attempt without re-taking the entire exam. This option is only available to those who score over 35% of the maximum total score of all sections not already passed. For such students, if the score in some sections is larger than 50%, those sections will be considered "passed" and they have to score at least 50% on the remaining sections in their next attempt in order

to pass the A to C requirement.
The faculty may establish requirements for the candidate to fulfill during his/her Ph.D. program to meet deficiencies that are noted during the exam. If he/she fails the second attempt, he/she cannot continue in the physics doctoral program.

After admission to candidacy and the selection of a research director, a doctoral committee will be appointed by the research director with the approval of the Director of Graduate Studies and the Dean of The Graduate School to provide guidance and oversee the student's program until its completion. This committee shall include at least three members of the Physics faculty and one member from the faculty of another department. The research director shall be chairman, and the committee should meet at least twice a year and report to the Director of Graduate Studies.

Residency Requirement for Doctoral Program
The residency requirement consists of 18 graduate credits in the student's program within a period of three consecutive major semesters (fall/spring). For more information, refer to the *Graduate Studies Bulletin*.

Foreign Language
A reading knowledge of one modern foreign language is required. This is normally demonstrated by passing an exam administered by the Department of Languages, Literatures, and Cultures (http://www.cas.sc.edu/dllc/Geninfo/reading_exam.html). French, German, or Russian is recommended. Other modern foreign languages may be used with the approval of the Director of Graduate Studies. Students for whom English is a foreign language may use a knowledge of English to satisfy this requirement.

Teaching Experience
Each candidate for the Ph.D. degree must have demonstrated an ability for effective teaching. This requirement is met by service as an instructor of a laboratory or a recitation section in an elementary course in physics. These teaching assignments are supervised by a member of the faculty, and it is to the faculty member that the ability for effective teaching must be demonstrated. At the end of each semester each student will be given an evaluation of his/her teaching performance by the professor in charge of the course.

Dissertation Proposal and Comprehensive Examination
After passing the Admission to Candidacy Examination the student must prepare and defend a research proposal within six months. This time requirement is necessary for the student to maintain the status of candidate for the doctoral degree. The proposal will be written and circulated to the doctoral committee at least one week before the day of the presentation. The doctoral committee will then conduct an examination of the proposed research and on the student's general background knowledge, the latter being referred to as the Comprehensive Examination. The committee will vote to pass or fail the student on both parts of the examination and perhaps make an additional recommendation. Furthermore, the examination must be held <u>not less than one year</u> before the dissertation defense. Students failing the comprehensive portion will be asked to repeat it at a time set by their doctoral committee. If the substance of the dissertation is markedly changed after the proposal is given, a new proposal may be required (to be scheduled not less than one year before the dissertation defense).

Dissertation

The dissertation should demonstrate that the Ph.D. candidate has mastered the field in which he/she has chosen to do research, is capable of doing independent scholarly work, and is able to formulate conclusions that will in some respect increase the extent of and/or improve our understanding of what is already known. In order to be acceptable as a Ph.D. dissertation, a manuscript reporting a significant part of the doctoral research results must have been submitted to a refereed research journal.

The maximum period permitted by the Graduate School for completion of the dissertation is five years after the Dissertation Proposal/Comprehensive Examination date. However, full-time physics graduate students are expected to complete their research in a considerably shorter time. Their progress will be reviewed every year at the beginning of the fall term by their doctoral committee, and failure to make reasonable progress can result in termination of financial support.

Dissertation Defense

The completed dissertation must be defended by the student before his/her doctoral committee at an oral examination. This oral examination consists of two parts. In the first part, which is open to all department faculty members and graduate students, the student will present a summary of his/her doctoral work and entertain questions from the audience. The second part is an examination of the student's dissertation. Only members of the doctoral committee may be present during the second part. The examination committee chairman will be someone other than the research director.

A copy of the completed dissertation must be submitted to the Director of Graduate Studies and to each of the members of the doctoral committee at least two weeks before the examination, and the examination itself must take place no less than thirty days before the candidate expects to receive the degree.

IX. REPRESENTATIVE CURRICULA FOR DOCTORAL PROGRAM

Two representative curricula are given on the next two pages. The first would be followed by students who must make up undergraduate deficiencies, while the second is intended for students prepared to take the graduate level courses immediately. Many students will follow programs between these two extremes.

Recommended Ph.D. Course Schedule (less well-prepared student)

First Year

Fall Semester

PHYS 5xx	500-level course (3-4 credits)
PHYS 5xx	500-level course (3 credits)
PHYS 5xx	500-level course (3 credits)
PHYS 515	Mathematical Physics I (3 credits)
PHYS 730	Graduate Seminar (1 credit)

Spring Semester

PHYS 5xx	500-level course (3-4 credits)
PHYS 5xx	500-level course (3-4 credits)
PHYS 5xx	500-level course (3 credits)
PHYS 516	Mathematical Physics II (3 credits)
PHYS 730	Graduate Seminar (1 credit)

Second Year

Fall Semester

PHYS 701	Classical Mechanics (3 credits)
PHYS 703	Electromagnetic Theory I (3 credits)
PHYS 711	Quantum Mechanics I (3 credits)
PHYS 730	Graduate Seminar (1 credit)
PHYS 760	Research (2 credits)

Spring Semester

PHYS 704	Electromagnetic Theory II (3 credits)
PHYS 712	Quantum Mechanics II (3 credits)
PHYS 5xx	500-level course (3 credits)
PHYS 761	Research (3 credits)

File the degree program

Take the Admission to Candidacy Examination

Third and Fourth Years

PHYS 706	Statistical Mechanics (3 credits)
PHYS 713	Advanced Quantum Theory (3 credits)
PHYS 7xx	Advanced 700-level courses (9 credits)
PHYS 760	Research (x credits)
PHYS 761	Research (x credits)
PHYS 899	Dissertation Preparation (12 credits)

<u>Recommended Ph.D. Course Schedule</u> (well-prepared student)

First Year

Fall Semester

PHYS 701	Classical Mechanics (3 credits)
PHYS 703	Electromagnetic Theory I (3 credits)
PHYS 711	Quantum Mechanics I (3 credits)
PHYS 730	Graduate Seminar (1 credit)
PHYS 760	Research (2 credits)

Spring Semester

PHYS 704	Electromagnetic Theory II (3 credits)
PHYS 712	Quantum Mechanics II (3 credits)
PHYS 7xx	700-level course (3 credits)
PHYS 730	Graduate Seminar (1 credit)
PHYS 761	Research (2 credits)

Take the Admission to Candidacy Examination

Second, Third, and Fourth Years

PHYS 706	Statistical Mechanics (3 credits)
PHYS 713	Advanced Quantum Theory (3 credits)
PHYS 7xx	Advanced 700-level courses (9 credits)
PHYS 760	Research (x credits)
PHYS 761	Research (x credits)
PHYS 899	Dissertation Preparation (12 credits)

X. AWARDS AND DEAN'S SUPPLEMENTAL STIPEND

Awards

The Department of Physics and Astronomy will award two graduate students every year - one for teaching and one for research. The award amounts are $1000 each.

Every year one graduate student will be awarded the Physics and Astronomy Graduate Student Teaching Award based on performance in teaching and grading of physics and astronomy courses. Nominations for the award can be made by any member of the department faculty and should be accompanied by a written endorsement of the candidate. Comparative evaluations of GTAs from the laboratory manager, the professor in charge of labs, and other teaching faculty will play an important role in deciding who receives the award. The recipient will be chosen by the department chairman and the Director of Graduate Studies in consultation with appropriate personnel.

Every year one graduate student will be awarded the Physics and Astronomy Graduate Student Research Award based on research performance. Nominations for the award can be made by any member of the department faculty and should be accompanied by a written endorsement of the candidate. Publications submitted by a student and/or other concrete evidence of research achievements will play an important role in deciding who receives the award. The recipient will be chosen by the department chairman and the Director of Graduate Studies in consultation with appropriate personnel.

Students may receive an award only once in their graduate career with this department, and students past their fifth year of graduate studies (second year for M.S. students) are automatically ineligible for the award.

These awards will be presented on Graduate Student Day (usually in April) at the annual university graduate awards ceremony.

Dean's Supplemental Stipends

The Dean of the College of Science and Mathematics offers supplemental stipends to graduate study applicants. The following rules have been adopted by the department to regulate these stipends:

1. Dean's Supplemental Stipends are only available to Ph.D. applicants.
2. If the stipend is lost, it is gone forever. Students cannot "make up" any deficiencies in any way.
3. Any student receiving the Dean's Supplemental Stipend who is a GTA must maintain a good teaching record to retain his/her supplemental stipend. The teaching record will be reviewed by the professor in charge of labs, by the Departmental Laboratory Manager, and by the Director of Graduate Studies.

Eligibility Rules

Only applicants who have exceptional GRE scores and undergraduate transcripts will be recommended for the Dean's Supplemental Stipend. The Dean will then offer the stipends based on availability and further review.

Retention Rules

For purposes of this document, "core" courses are defined as PHYS 701, 703, 704, 711, 712 and 713.

1. Students who take 500-level courses in their first year (if so advised by the Advisement Committee) must have a minimum grade of B+ in all 500-level courses taken.
2. In their first year, students must take a minimum of 12 credit hours. Their GPA in core courses must be a minimum of 3.4 OR they must pass the A to C exam before their second year.
3. In their second year, students must complete all remaining core courses. At the end of the second year, the GPA in core courses taken in the second year must be at least 3.4 to retain the supplemental stipend for the third year.
4. A to C exam: Students must have passed this exam by the end of their second year.
5. 5. Ph.D. candidates: Once students have passed their A to C exam, they must complete their dissertation proposal (in six months) and pass their Comprehensive Exam. 6. Students must have the approval of their committee to retain the supplemental stipend into their fourth year (third year for fast track students).

XI. GRADUATE COURSE DESCRIPTIONS

Overview

The Department of Physics and Astronomy offers programs in physics leading to the degrees of Master of Science, and Doctor of Philosophy; the Master of Arts in Teaching is offered in cooperation with the College of Education.

Fields of Specialization

Research opportunities are currently available in theoretical physics, general relativity, astrophysics, experimental and theoretical hadronic physics, high energy physics, neutrino physics, chemical physics, experimental and theoretical solid state physics, magnetic

resonance, magnetic properties, cryogenics, transport properties, high temperature superconductivity, computational physics, and physics education.

Admission

Adequate preparation for graduate study ordinarily presupposes a bachelor's degree in physics or an allied field. Students who lack some of the usual undergraduate courses in physics may be required to take additional course work as a part of their program.

Course Descriptions

Astronomy (ASTR)

533 – Advanced Observational Astronomy I. (1-3) (Prereq: consent of instructor) Development of a combination of observational techniques and facility at reduction of data. A maximum of eight hours per week of observation, data reduction, and consultation. Offered each semester by arrangement with the department.

534 – Advanced Observational Astronomy II. (1-3) A continuation of ASTR 533. Up to eight hours per week of observation, data reduction, and consultation.

599 – Topics in Astronomy. (3) (Prereq: consent of instructor) Readings and research on selected topics in astronomy. Course content varies and will be announced in the schedule of classes by suffix and title.

Physics (PHYS)

The minimum prerequisites for all 500 level courses listed below are two years of physics and mathematics through calculus. Further prerequisites are listed where applicable.

501 – Quantum Physics. (3) Principles of special relativity, origin and development of quantum theory, and elements of nuclear and particle physics.

502 – Quantum Physics. (3) A self-contained treatment of quantum theory and its applications, beginning with the Schroedinger equation.

503 – Mechanics. (4) Classical mechanics of particles, systems, and rigid bodies; discussion and application of Lagrange's equations.

504 – Electromagnetic Theory. (4) (Prereq: PHYS 503) Field theory of electric and magnetic phenomena: Maxwell's equations applied to problems in electromagnetism and radiation.

506 – Thermal Physics. (3) Principles of equilibrium thermodynamics, kinetic theory, and introductory statistical mechanics.

509 – Solid State Electronics. (4) Topics include: basic electrical circuits, electronic processes in solids, operation and applications of individual solid state devices, and integrated circuits. Three lecture and three laboratory hours per week.

510 – Digital Electronics. (3) (Prereq: PHYS 509) Basic operation of digital integrated circuits including microprocessors. Laboratory application of microcomputers to physical measurements.

511 – Nuclear Physics. (4) (Prereq: PHYS 502) An elementary treatment of nuclear structure, radioactivity, and nuclear reactions. Three lecture and three laboratory hours per week.

512 – Solid State Physics. (3) (Prereq: PHYS 502) Crystal structure, lattice dynamics, thermal, dielectric, and magnetic properties of solids. Free electron model for metals. Band structure of solids, semiconductor physics.

514 – Optics, Theory and Applications. (4) Geometrical and physical optics; the wave nature of light, lenses and optical instruments, interferometers, gratings, thin films, polarization coherence, spatial filters, and holography. Three lectures and one three-four hour laboratory per week.

515 – Mathematical Physics I. (3) Analytical function theory including complex analysis, theory of residues, and saddlepoint method. Hilbert space, Fourier series, and Fourier transformations. Elements of distribution theory. Vector and tensor analysis with tensor notation.

516 – Mathematical Physics II. (3) (Prereq: PHYS 515) A short introduction to group theory, linear second order differential equations, and the properties of the transcendental functions. Orthogonal expansions. Integral equations.

517 – Computational Physics. (3) Application of numerical methods to a wide variety of problems in modern physics including classical mechanics and chaos theory, Monte Carlo simulation of random processes, quantum mechanics, and electrodynamics.

531 – Advanced Physics Laboratory I. (1-3) A laboratory program designed to develop a combination of experimental technique and the application of the principles acquired in formal course work. Up to eight hours per week of laboratory and consultation.

532 – Advanced Physics Laboratory II. (1-3) A continuation of PHYS 531. Up to eight hours per week of laboratory and consultation.

599 – Topics in Physics. (1-3) (Prereq: consent of instructor) Readings and research on selected topics in physics. Course content varies and will be announced in the schedule of classes by suffix and title.

701 – Classical Mechanics. (3) Generalized coordinates, Lagrangian and Hamiltonian formulations, variational principles, transformation theory, and Hamilton-Jacobi equation.

703 – Electromagnetic Theory I. (3) Development of Maxwell's equations; boundary value problems; radiation theory.

704 – Electromagnetic Theory II. (3) A continuation of PHYS 703.

706 – Statistical Thermodynamics. (3) Statistics of Boltzmann, of Fermi and Dirac, and of Bose and Einstein, with applications.

708 – General Relativity. (3) Introduction to the basic concepts of general relativity and a discussion of problems of current interest.

711 – Quantum Mechanics I. (3) A development of non-relativistic quantum mechanics.

712 – Quantum Mechanics II. (3) A continuation of PHYS 711.

713 – Advanced Quantum Theory I. (3) Non-relativistic quantum electrodynamics. Relativistic wave equations. Propagator theory. Field theory of relativistic quantum electrodynamics.

714 – Advanced Quantum Theory II. (3) A continuation of PHYS 713.

717 – Nuclear Theory. (3) The theory of nuclear forces, structure, and reactions.

721 – Nuclear Physics. (3) Nuclear physics, mainly from the experimental standpoint.

723 – Elementary Particles I. (3) (Prereq: PHYS 701, 703, 711; Coreq: 712) Introduction to elementary particles. The quark model. Symmetry principles and conservation laws. Calculation of cross sections and decay rates using Feynman rules. Accelerators, particle detectors, and experiments. Electromagnetic cross sections.

724 – Elementary Particles II. (3) (Prereq: PHYS 723) Experimentally accessible processes and their description using the framework developed in PHYS 723. Gauge theories and the standard model. Particle experiments for the next decade and their underlying physics descriptions.

725 – Solid State Physics. (3) The crystalline state of matter and its main characteristics. Electric and magnetic properties of metals, semiconductors, and insulators.

726 – Superconductivity. (3) Theory and description of conventional and high temperature superconductors and their properties.

727 – Magnetic Resonance. (3) Basic theory. Electron spin resonance. High resolution and wideline nuclear magnetic resonance. Mössbauer effect. Magnetic resonance and dielectric relaxation.

728 – Solid State Theory. (3) Presentation of the quantum theory of solids. Applications to acoustic, electric, magnetic, optical, and superfluid properties of solids.

729 – Applied Group Theory. (3) Groups and representations. Full rotational group. Angular momentum. Ligand field theory. Application to atomic, molecular, and nuclear physics.

730 – Graduate Seminar. (1) Presentation by the student of a designated topic. May be repeated for credit.

740 – Selected Topics in Physics. (1-3 per registration) Course content varies and will be announced in the schedule of classes by suffix and title.

745 – Topics in Nuclear Physics. (1-3 per registration) Course content varies and will be announced in the schedule of classes by suffix and title.

750 – Topics in Solid State Physics. (1-3 per registration) Course content varies and will be announced in the schedule of classes by suffix and title.

755 – Topics in Theoretical Physics. (1-3 per registration) Course content varies and will be announced in the schedule of classes by suffix and title.

760 – Research. (1-6) Introduction to and the application of the methods of research.

761 – Research. (1-6) Introduction to and the application of the methods of research.

781 – Astronomy for Teachers. (3) Primarily for M.A.T./I.M.A. and M.Ed. students. Not available for M.S. and Ph.D. credit in physics. A one-semester survey of astronomy. Observational techniques and current developments.

782 – Topics in Contemporary Physical Sciences for Teachers. (variable 3-4) Primarily for M.A.T. and M.Ed. students. Not available for M.S. and Ph.D. credit in physics. Discussions designed to provide teachers with simple physical explanations of subjects including: nuclear energy, black holes, quarks, strange particles, perception of color integrated circuits, computers, T.V. games, and other topics of current interest. With four hours credit a laboratory will be included to give laboratory experience in the subject areas covered in class.

783 – Modern Physics for Teachers. (3) Primarily for M.A.T. and M.Ed. students. Not available for M.S. and Ph.D. credit in physics. Basic concepts of modern physics. The experimental basis for quantum theory and the theory of relativity. Fundamental concepts of modern physics.

784 – Topics in Light and Sound for Teachers. (3) Primarily for M.A.T. and M.Ed. students. Not available for M.S. and Ph.D. credit in physics. Topics in modern optics and acoustics are discussed in a framework appropriate for school teachers.

785 – Electronics for Teachers. (3) Primarily for M.A.T. and M.Ed. students. Not available for M.S. and Ph.D. credit in physics. Basic electronics with emphasis on measurement and laboratory procedures. Operation and application of semiconductor devices and integrated circuits.

786 – Teaching Physics on the Internet. (3) Web-based resources for assigning and grading individualized homework and tests and for creating instructional units in physics and physical sciences. Not available for M.S./Ph.D. physics majors.

787 – Design of Physics Laboratory and Demonstration Experiments for Teachers. (3) Primarily for M.A.T. and M.Ed. students. Not available for M.S. and Ph.D. credit in physics. Design and performance of demonstrations and experiments to display physical phenomena to students. Qualitative and quantitative experiments.

788 – Physics for AP Teachers. (3) Preparation of teachers for developing and teaching an advanced placement course in physics. Primarily for M.A.T./I.M.A. and M.Ed. students. Not available for M.S. or Ph.D. credit in physics.

789 – Physics for Teachers of Mathematics. (3) Teacher preparation for creating and solving word problems using conservation laws and symmetries found in physics and physical science and linked to the South Carolina Mathematical Standards.

799 – Thesis Preparation. (1-9)

899 – Dissertation Preparation. (1-12)

XII. PROGRAM RELATED FORMS

M.S. and Ph.D. Student Progress and Information

The student progress and information forms are used only in the Department of Physics and Astronomy. They serve as guides to assist students in planning and tracking their progress in the graduate program.

Programs of Study

All degree students must file a program of study in The Graduate School. The program of study is a list of courses that fulfill degree requirements. It must be approved by the advisor, the director of graduate studies, and the Dean of The Graduate School as stated in the *Graduate Studies Bulletin*.

Doctoral Committee Appointment Request

Once a student has been admitted to candidacy, a doctoral committee should be formed. The committee must consist of at least three members from the faculty of the Department of Physics and Astronomy and one member from the faculty of another department. The committee must be approved by the Director of Graduate Studies and the Dean of The Graduate School.

M.S. STUDENT PROGRESS AND INFORMATION

NAME _____ **SSN** _____

START DATE _____ **AREA OF INTEREST** _____

DEGREE DATE _____ **MAJOR PROFESSOR** _____

- **ENGLISH EXAM PASS DATE** (IF APPLICABLE) _____
- **PROGRAM OF STUDY DATE** _____
- **COMMITTEE MEMBERS**
  - **1ST READER** _____
  - **2ND READER** _____
- **COMPREHENSIVE EXAM DATE** _____
- **DEFENSE DATE** _____

➢ **AT LEAST 18 HOURS 700 LEVEL**

MUST INCLUDE 711 AND 701, 703, 704, 706, OR 712
- UP TO 6 HOURS OF 799 MAY BE USED
- CANNOT USE 730, 740, 760, 761

COURSE	DATE	GRADE	CREDITS
711			3
7____			
7____			
7____			
7____			
7____			
7____			

➢ **UP TO 12 HOURS 500 LEVEL** (IF APPLICABLE)

COURSE	DATE	GRADE	CREDITS
5____			
5____			
5____			
5____			

➢ **ADDITIONAL COURSES**

COURSE	DATE	GRADE	CREDITS

PH.D. STUDENT PROGRESS AND INFORMATION

NAME _____ **SSN** _____

START DATE _____ **AREA OF INTEREST** _____

DEGREE DATE _____ **MAJOR PROFESSOR** _____

- **PROGRAM OF STUDY** ____ / ____ / _____
- **FOREIGN LANGUAGE: Language** _____ **Date Passed** _____ / _____
- **ADMITTED TO CANDIDACY** ____ / _____

  Attempt 1: Date ___ / ____ ☐ **Pass** ☐ **Fail**
  Attempt 2: Date ___ / ____ ☐ **Pass** ☐ **Fail**

- **DOCTORAL COMMITTEE** _____ / _____ / _____

  Chair _____

  Member _____ **Outside** _____

  Member _____ **Other** _____

- **COMPS / PROPOSAL** ____ / ____ / _____
- **DEFENSE** _____ / _____ / _____

➢ **REQUIRED COURSES**

Course	Date	Grade	Credits
701			3
703			3
704			3
706			3
711			3
712			3

➢ **12 ADDITIONAL CREDITS OF 700 LEVEL**
– not 730, 740, 760, 761

Course	Date	Grade	Credits
7___			
7___			
7___			
7___			
7___			

➢ **DISSERTATION PREPARATION** (12 credits)

Course	Date	Grade	Credits
899			
899			
899			
899			
899			
899			

➢ **RESEARCH** (760, 761)

Course	Date	Grade	Credits
76__			
76__			
76__			
76__			
76__			
76__			

- **ADDITIONAL COURSES**

Course	Date	Grade	Credits	Course	Date	Grade	Credits

- **ADDITIONAL INFORMATION**

**Do not use this form. The original may be downloaded from The Graduate School.*

Masters Degree or Certificate Program of Study MPOS

YOU MUST HAVE ADOBE ACROBAT STANDARD OR PROFESSIONAL TO SAVE DATA,
ADOBE ACROBAT READER WILL ONLY ALLOW YOU TO PRINT

Name: Last Name | First Name | Middle Name **SSN:**

Address: Street | Apt, if any | City | State | Zip Code

Degree: **Major:** **Track:**

Admitted to Program: Foreign Language required: Date Completed

Other Requirements:

PROGRAM OF COURSES

In the spaces provided below, list all courses for which approval is requested in the master's degree (including thesis, if required) or certificate program.. Example: ENGL 751 Amer. Novel in 20th Cent. Do not list courses not specifically required for the master's or certificate program. Note that any course on this program which exceeds the 6 year limit (before the degree is awarded) must be revalidated or replaced with another course.

Dept Prefix	Course Number	Abbreviated Course Title	Term Completed	Date	Credit Hours	Grade	Where Taken

Approved

Student Signature Date: Graduate Director of School of Dept Date:

Major Professor/Chair of Adv Committee Date: Dean of the Graduate School Date:

**Do not use this form. The original may be downloaded from The Graduate School.*

DPOS

USC Doctoral Degree Program of Study

ENTER (TYPE) INFORMATION INTO FORM AND THEN PRINT DOCUMENT

YOU MUST HAVE ADOBE ACROBAT STANDARD OR PROFESSIONAL TO SAVE DATA, ADOBE ACROBAT READER WILL ONLY ALLOW YOU TO PRINT

Name: Last Name | First Name | Middle Name **SSN:**

Address: Street | Apt, if any | City | State | Zip Code

Degree: **Major:** **Track:**

Doctoral Residency Course Work:
(18 hours within 3 major semesters taken after admission to the doctoral program.)

Term	Year	Course Numbers

Admitted to Doctoral Candidacy:

Advisory Committee Approved:**

Foreign Languages required:

1. Date Completed

2. Date Completed

PROGRAM OF COURSES

In the spaces provided below, list all courses for which approval is requested in the doctoral program, including dissertation courses. Example: ENGL 751 Amer. Novel in 20th Cent. This program must include at least 18 semester hours, other than 899, which are not used on any other degree program. Do not list courses not specifically required for this student's doctoral program. Note that any course on this program which exceeds the 8 year limit before the degree is awarded must be revalidated or replaced with another course.

Dept Prefix	Course Number	Abbreviated Course Title	Term Completed	Date	Credit Hours	Grade	Where Taken

Approved

Student Signature Date: Graduate Director of School or Dept Date:

Major Professor/Chair of Adv Committee Date: Dean of the Graduate School Date:

**Do not use this form. The original may be downloaded from The Graduate School.*

DCAR

DOCTORAL COMMITTEE APPOINTMENT REQUEST

THE GRADSCHOOL PREFERS TYPED DOCUMENTS. ENTER (TYPE) INFORMATION IN FORM AND THEN PRINT DOCUMENT

(YOU MUST HAVE ADOBE ACROBAT STANDARD OR PROFESSIONAL TO SAVE DATA, ADOBE ACROBAT READER WILL ONLY ALLOW YOU TO PRINT)

Mail to:
The Graduate School
901 Sumter St. #304
Columbia, SC 29208
Fax to:
803-777-2972

1. Student fills in form.
2. Student prints completed form.
3. Student signs completed form.
4. Student has graduate director sign form.
5. Student/last signatory faxes/mails form to The Graduate School.

Last Name: **First Name:** **M.I.** **SSN#**

Street: **City:** **State:** **Zip:**

Department/Program: **Major:** **Degree Sought:**

INSTRUCTIONS: Complete each item above. Check the appropriate committee(s) to which this request applies to assure compliance with Graduate School policy. Each committee must include an outside member and at least three other members with two or more members from the student's major degree program.

Please check as applicable:

1. ☐ **Written and Oral Comprehensive Examination Committee**
2. ☐ **Dissertation Committee and Dissertation Defense Committee**

Committee Membership Composition (Please type or Print):

1. Major Professor/Research Director:

2. Member (Major Degree Program):

3. Member:

4. Member:

5. Member

6. Outside Member:

Name of USC department/program or other institution affiliation:

==========

APPROVAL:

Graduate Director: _____ Date: _____

Dean of the Graduate School: _____ Date: _____

GS4B rev 1/2004